Future Roles of Glass in Solar Energy Technology

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Abstract

Glass is a crucial auxiliary component of the photovoltaic (PV) cells, which acts as a cover and/or a substrate for the thin film semiconductor PV cells. In the future, glass will certainly play an even more important role in enhancing the energy conversion efficiency (ECE) of the PV cells. Here I present some ideas about how to improve the chemical and physical performances of glasses in order to further increase the ECE of the PV cells. One of the best ways is to add new features and functions to the cover or substrate glasses used in PV cells by performing post-treatment on the glass surface. The treated glass should transmit a maximum amount of light at optimum wavelengths to a semiconductor film for generating electrical energy. At the same time, the treated glasses should exhibit improved chemical, thermal and mechanical performances of these glasses in PV modules. There are different post-treatment approaches to create glass surfaces that can trap a maximum amount of light for energy conversion, e.g., by coating a thin film on glass, or by patterning the glass surfaces. In this paper I first review these approaches, and then report a new approach for potentially making optimal glass used for PV cells, namely, the reduction - inward diffusion approach that has recently been established by M. M. Smedskjaer and myself. The principle of the approach is to create a thin silica-rich layer on glass by reducing the transition ions in glass from higher to lower valence state, and thereby inducing the cationic inward diffusion. The layer increases the mechanical, thermal and chemical durability of the glass and therefore the overall stability of the PV cells. Due to the increased thermal stability of the glass, the semiconducting film can be coated on a glass at a higher temperature and this ensures the coating quality and provides higher performance PV panels. Furthermore, the layer will block the diffusion of modifying ions from glass into the conducting layer of PV cell, and therefore the expensive SiO_2 or Si_3N_4 coating step may be avoided. When the glass is doped with two or more kinds of well-selected transition metals, the florescence effect will be generated in glasses, which is crucial for enhancing the ECE of PV cells.

Biography

Yuanzheng Yue, male, a glass scientist, got his Ph.D. degree in 1995 from Berlin University of Technology, Germany. He worked as a research fellow from 1996 to 1998 at both Berlin University of Technology and Jena University. Since 1998, he has been working first as an associate professor and then as a full professor at Aalborg University, Denmark. He established a research group of glass science at Aalborg University in 2003 and has been the group leader since then. He is a Taishan Scholar Professor of Shandong Polytechnic University and a visiting chair professor of Shandong University in China. He is a council member of the International Commission on Glass, and a member of American Ceramic Society and German Society of Glass Technology. He serves as an editor of European Journal of Glass Science and Technology and a reviewer of more than 40 journals. So far, he has published about 170 scientific papers including those in high impact journals such as *Nature, PNAS, Phys. Rev. Lett., J. Am. Chem. Soc*. as the first or the corresponding authors; has given 44 invited talks at international conferences; has published 2 proceeding books. He has organized several national and international conferences and acted as a session chair of numerous international conferences and symposiums.